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FOREST PEST MANAGEMENT

3430 BIOLOGICAL EVALUATION

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Results of an Egg Mass Survey on the Pike and San Isabel, and Arapaho and Roosevelt National Forests in 1980

United States Department of
Forest Service
Forest Pest Management
Denver Colorado

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WESTERN SPRUCE BUDWORM

Results of an Egg Mass Survey on the
Pike and San Isabel, and Arapaho and
Roosevelt National Forests in 1980

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ABSTRACT

The western spruce budworm defoliated over one million acres of Douglas-fir and white fir in Colorado during 1980. Approximately 700,000 acres were defoliated within the boundaries of the Pike and San Isabel, and Arapaho and Roosevelt National Forests, and about 340,000 acres of defoliation occurred on adjacent private lands. Egg mass densities are again sufficient to cause moderate to heavy defoliation on the Pike and Roosevelt National Forests, while light defoliation is expected within the areas sampled on the San Isabel National Forest during 1981.

INTRODUCTION

The western spruce budworm is the most serious defoliator of Douglas-fir and white fir forest types in the Rocky Mountain Region. Periodic epidemics have caused widespread and occasionally severe defoliation. Forest Pest Management monitors the western spruce budworm through annual aerial detection and egg mass surveys. These surveys are conducted to provide historical records of the activity of the budworm within the Region and to provide concerned land managers with information on the distribution and damage caused by the insect. In addition, a forecast of future activity is made.

Since 1974, Douglas-fir and white fir stands on the Pike and San Isabel National Forests and Douglas-fir stands on the Arapaho and Roosevelt National Forests have been sustaining damage from epidemic budworm populations. The surveys described in this report were conducted on the Pike and San Isabel, and the Roosevelt National Forests during July and August, 1980. Egg mass sample locations are areas of past and present chronic budworm activity. Not all budworm infested areas were sampled because of constraints on manpower and travel. However, if identified, additional areas of interest could be sampled in 1981.

BIOLOGY OF WESTERN SPRUCE BUDWORM

The western spruce budworm, *Choristoneura occidentalis* Freeman, is the principal defoliator in spruce-fir forest types in the West. In Colorado, the budworm's preferred hosts are Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, and white fir, *Abies concolor* (Gord. and Glend.) Linbl.. Subalpine fir, *A. lasiocarpa* (Hook.) Nutt., Engelmann spruces, *Pinus engelmannii* Parry, and blue spruce *P. pungens* Engelm., are also attacked.

The western spruce budworm has one generation per year in Colorado. Adult moths emerge and mate in July. Females may lay a partial compliment of eggs shortly after mating, the remainder are deposited after a migration period. Eggs are deposited in masses cemented to the undersides of host tree needles and hatch in ten days. The newly hatched larvae do not feed, but seek hiding places under bark scales on branches, in twig crotches, or among lichens where they spin silken shelters (hibernacula) and overwinter.

In the spring, larvae disperse to the foliage where they mine needles for one to two weeks. About the time buds begin to expand, larvae move into the buds and later, as the new shoots expand, spin loose feeding webs between shoots. Larvae prefer to feed on new foliage and become full grown in 30 to 40 days after feeding begins in the spring. Pupation

takes place in feeding webs or on the foliage. Adult moths are not strong flyers, but may be carried considerable distances by air currents.

EXTENT OF OUTBREAK

Budworm occurs in all Douglas-fir, and true fir forest types within the Region. The largest contiguous outbreak occurs on the Front Range of Colorado, principally on the Pike and San Isabel, and Arapaho and Roosevelt National Forests and adjacent ownerships of private, state and other Federal lands. In 1980, over one million acres were infested in Colorado. Budworm infested acreage is as follows:

Unit [1]	Infested Acreage
Roosevelt N.F.	180,680
Arapaho N.F.	15,108
Pike N.F.	430,539
San Isabel N.F.	74,419
Gunnison N.F.	6,348
San Juan N.F.	6,639
other Federal, State and Private	338,284
TOTAL	1,052,017 acres

Acreages infested by budworm were determined from low-level aerial sketch maps made at the time of peak defoliation.

HOST STAND CONDITION

Mature stands of mixed Douglas-fir and white fir in the southern Front Range and Douglas-fir in the northern Front Range have suffered extensive and occasionally severe defoliation (up to 100% of new growth) since the early 70's. The severity of tree damage caused by the western spruce budworm is directly related to the intensity and duration of defoliation. Stands displaying good vigor and growth can withstand occasional or possibly one or two consecutive years of heavy budworm feeding without significant injury. However, stands displaying poor vigor and growth (overmature and overstocked stands) will suffer varied amounts of tree injury depending on the intensity and duration of defoliation. Generally, budworm

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[1] Acreage figures for national forests include private and other federal lands within forest boundaries.

infestations cause varied amounts of tree deformity, seedling damage, seed destruction, and stand regeneration failure. Stands subjected to three and possibly four or more consecutive years of severe defoliation may incur top-killing, and an indeterminate amount of tree mortality principally in the smaller size class trees (<5" d.b.h.). Radial growth of defoliated trees may be reduced through the duration of the infestation. Recovery of defoliated trees is rapid. In as little as two to three years after the cessation of budworm feeding, stands recover to near normal appearance.

EVALUATION METHODS

Egg mass surveys are the principal tool in evaluating budworm population trends and subsequent defoliation. The survey consists of sampling individual trees to estimate budworm egg mass density and defoliation. Sampling is accomplished using a fixed plot, cluster sampling scheme.

Sample plots were located within budworm infested areas on national forests. Plots consisted of three dominant or co-dominant Douglas-fir within close proximity. Two 27 inch foliated branches were pruned from the midcrown of each sample tree for a total of six branches per plot. These foliage samples were bagged, labeled, and transported to a lab to determine new egg mass densities. The segregation of new from old egg masses were made using a microscope. Current year defoliation estimates were made by examining 100 new shoots from each sample tree. Egg mass and defoliation data were compiled and analyzed using a computer program developed by the Forest Service, Methods Application Group, Davis, California.

Defoliation predictions are based on estimates of egg mass densities. Defoliation classes and corresponding egg mass densities are reported in Table 1. These classes are adopted from McKnight (1967) and refined based on three years data from the fixed plot, cluster tree sampling scheme.

RESULTS

San Isabel National Forest: Aerial surveying of the forest revealed there were approximately 74,000 acres of defoliation (Figure 1). Defoliation was light in the Wet Mountains and Sangre de Cristo Mountains (Pass Creek to Westcliff). Heavy defoliation was observed in the LaVeta Spanish Peak area. No defoliation was visible from the air over the Oak Creek sample plots.

This year egg mass sampling was limited to the Wet Mountains area. Results of the sampling are presented in Table 2. Comparisons of egg

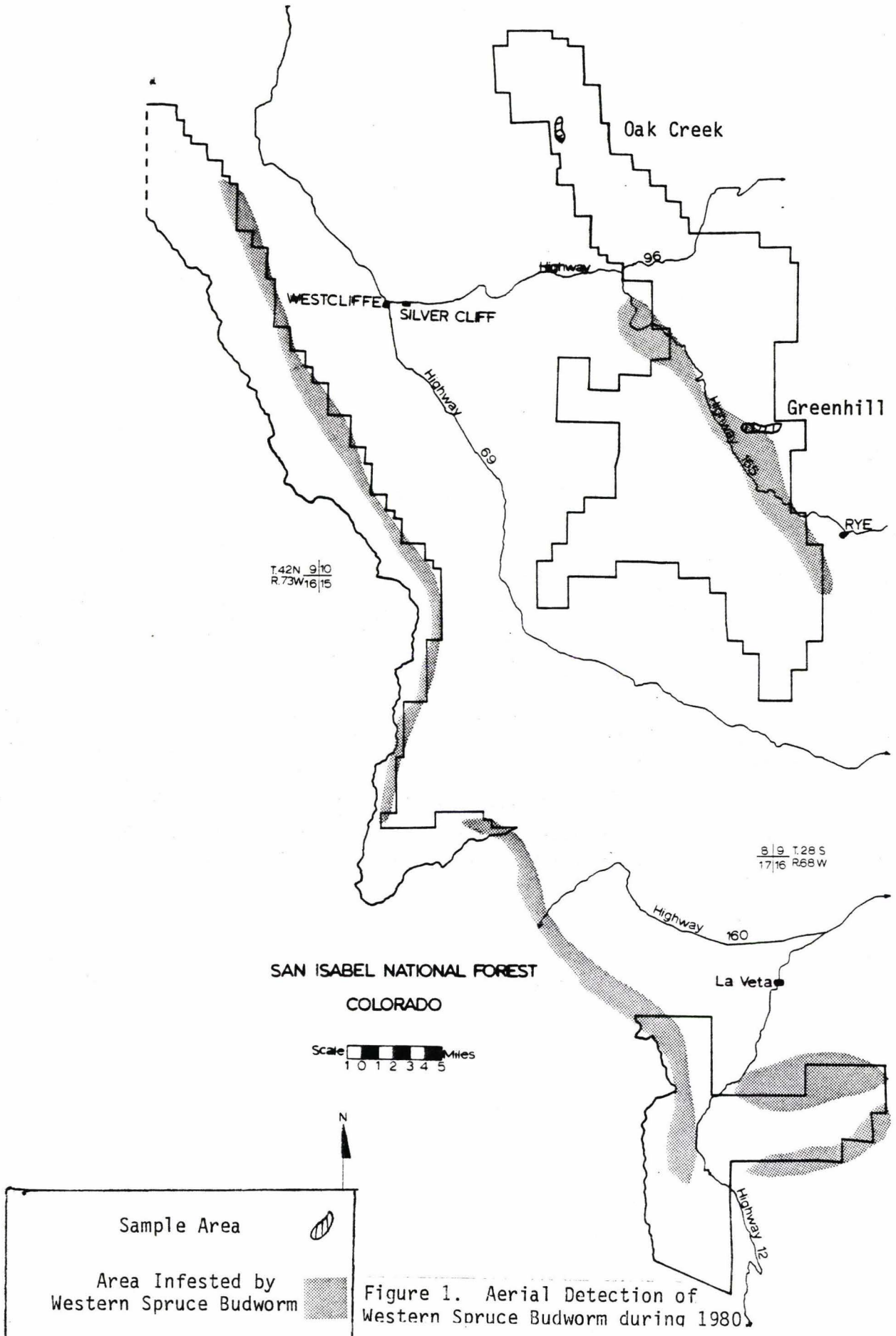

Figure 1. Aerial Detection of Western Spruce Budworm during 1980.

TABLE 1. Defoliation Prediction Classes for Western Spruce Budworm Egg Mass Sampling in Colorado.

Class	Mean Number of New Egg Masses per Square Meter Foliage	Defoliation Prediction [1]
1	1.6 or less	Undetectable
2	1.7 to 10.0	Light
3	10.1 or more	Moderate to Heavy

[1] Defoliation expected on new growth only

Undetectable	0 - 10%
Light	10 - 35%
Moderate	35 - 65%
Heavy	65 - 100%

TABLE 2. Results of Western Spruce Budworm Egg Mass Sampling on the San Isabel National Forest

Area[1]	Number of Branch Samples	Mean Number of New Egg Masses per Square Meter Foliage	1980 Defoliation Estimate	1981 Defoliation Prediction[2]
Greenhill Divide - Beulah	78	6.8	Light	Light (Class 2)
Oak Creek	30	4.9	Light	Light (Class 2)
Summary	108	5.8	Light	Light (Class 2)

[1] See Figure 1 for the location of sampling areas.
[2] Table 1 explains defoliation catagories.

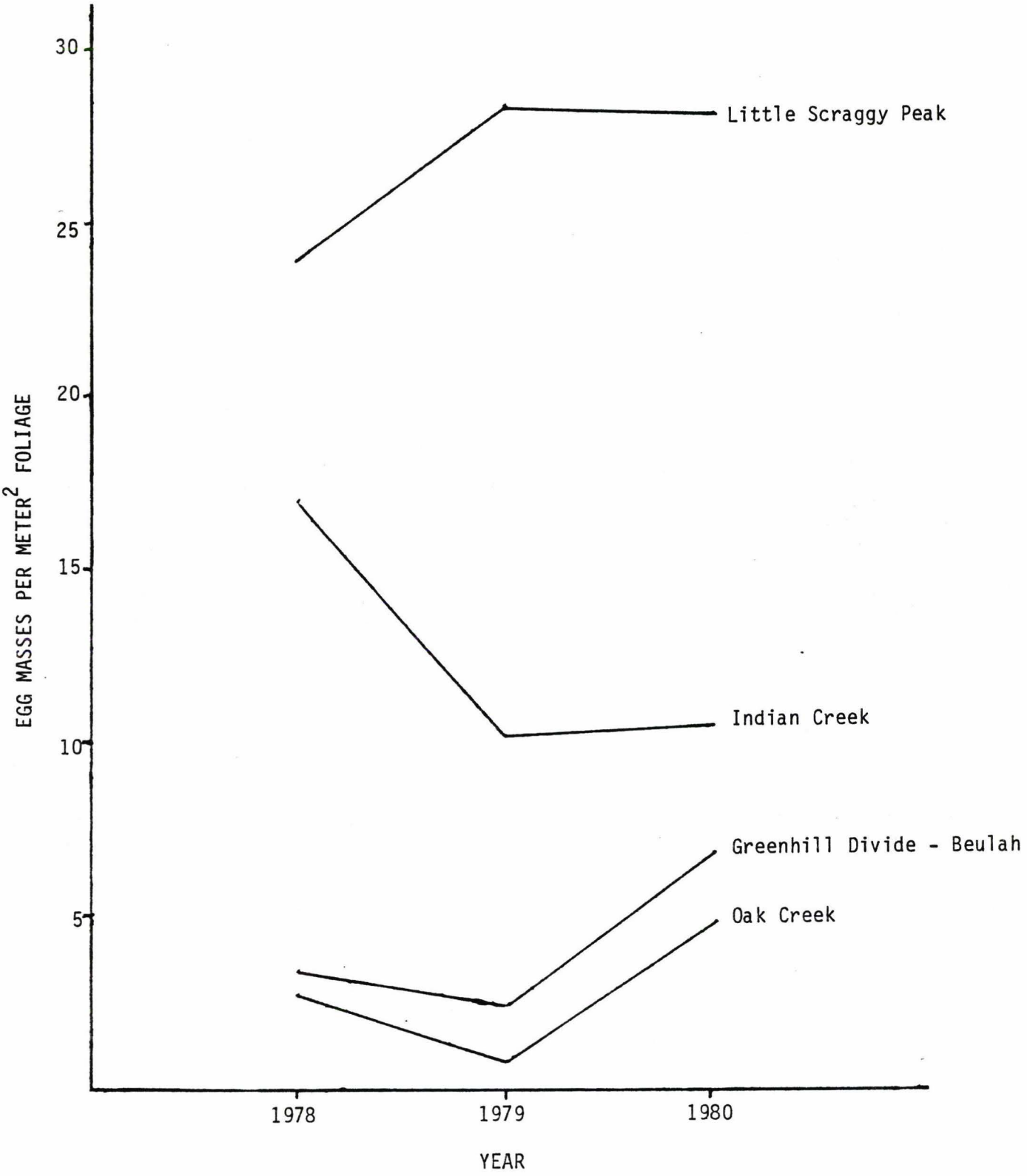

Figure 2. Western spruce budworm egg mass density trends for the Pike and San Isabel National Forest. Densities based on permanent sample plots. 1/

1/ Trend information for the Ormes Peak and Bailey sampling locations is incomplete.

mass density from permanent sample plots in the Greenhill Divide - Beulah area and the Oak Creek area show an increase over 1979 levels, but still remain within the light catagory. Egg mass density trends for the past 3 years are presented in Figure 2. Predicted defoliation in 1981 is light.

Pike National Forest: Egg mass surveys on this forest were conducted in four areas (Figure 3). Results of the sampling are presented in Table 3. Generally, egg mass densities remain near 1979 levels. Aerial surveying/ sketch mapping indicated approximately 430,000 acres of defoliation (Figure 3) in the light to moderate catagories. Egg mass density trends for the Indian Creek and Little Scraggy Peak sampling areas are illustrated in Figure 2.

Predictions for 1981 are moderate to heavy (class 3) defoliation. Tree damage does not appear severe. However, top-kill is evident in some locations having epidemic budworm populations for 4 years. Egg mass sampling in the vicinity of Bailey was accomplished by Dave Pieper of South Platte Ranger District.

Roosevelt National Forest: Four areas were intensively sampled. Survey results are presented in Table 4. Aerial surveys indicated approximately 180,000 acres of defoliation (Figures 4 & 5).

The Roosevelt National Forest continues to sustain some of the highest budworm populations within the Front Range. Tree damage is the most severe of any Front Range Forest. Predictions for 1981 defoliation again fall into the moderate to heavy (class 3) catagory. Egg mass density trends for the past 3 years are illustrated in Figure 6. Data were collected on permanent sample plots in the Big Elk Meadows, Devil's Gulch, and Magnolia areas.

SUMMARY

San Isabel National Forest: Aerial surveys indicated budworm activity increased in the Spanish Peaks area. While acreage infested in the Wet Mountains area decreased. Although egg mass densities increased in 1980 (Wet Mountains), tree damage is not severe and many stands are recovering from past years damage. Light defoliation is predicted in 1981.

Pike National Forest: Budworm populations appear static on this Forest. Despite relatively high budworm populations and large infestation area, overall tree damage is not severe. Species composition and site conditions may be responsible for less than expected tree damage. The Douglas-fir component of mixed pine Douglas-fir stands exhibits less budworm damage than trees in nearly pure Douglas-fir stands. However, severe defoliation and tree damage does exist in Douglas-fir stands, particularly in northern end of the Forest. Moderate to heavy defoliation is predicted in 1981.

TABLE 3. Results of Western Spruce Budworm Egg Mass Sampling on the Pike National Forest

Area[1]	Number of Branch Samples	Mean Number of New Egg Masses per Square Meter Foliage	1980 Defoliation Estimate	1981 Defoliation Prediction[2]
Little Scraggy Peak	120	28.2	Moderate	Moderate to Heavy (Class 3)
Indian Creek	150	10.7	Light	Moderate to Heavy (Class 3)
Ormes Peak	30	15.9	Light	Moderate to Heavy (Class 3)
Bailey	90	23.5	Moderate	Moderate to Heavy (Class 3)
Summary	390	19.6	Light to Moderate	Moderate to Heavy (Class 3)

[1] See Figure 3 for the location of sampling areas.
[2] Table 1 explains defoliation catagories.

TABLE 4. Results of Western Spruce Budworm Egg Mass Sampling on the Roosevelt National Forest

Area[1]	Number of Branch Samples	Mean Number of New Egg Masses per Square Meter Foliage	1980 Defoliation Estimate	1981 Defoliation Prediction[2]
Big Elk Meadows	120	59.5	Heavy	Moderate to Heavy (Class 3)
Magnolia	60	19.0	Moderate	Moderate to Heavy (Class 3)
Devil's Gulch	30	36.5	Moderate	Moderate to Heavy (Class 3)
Red Feather Lakes	50	20.11	Light	Moderate to Heavy (Class 3)
Summary	260	33.8	Moderate	Moderate to Heavy (Class 3)

[1] See Figures 4 and 5 for locations of sampling area.
[2] Table 1 explains defoliation catagories

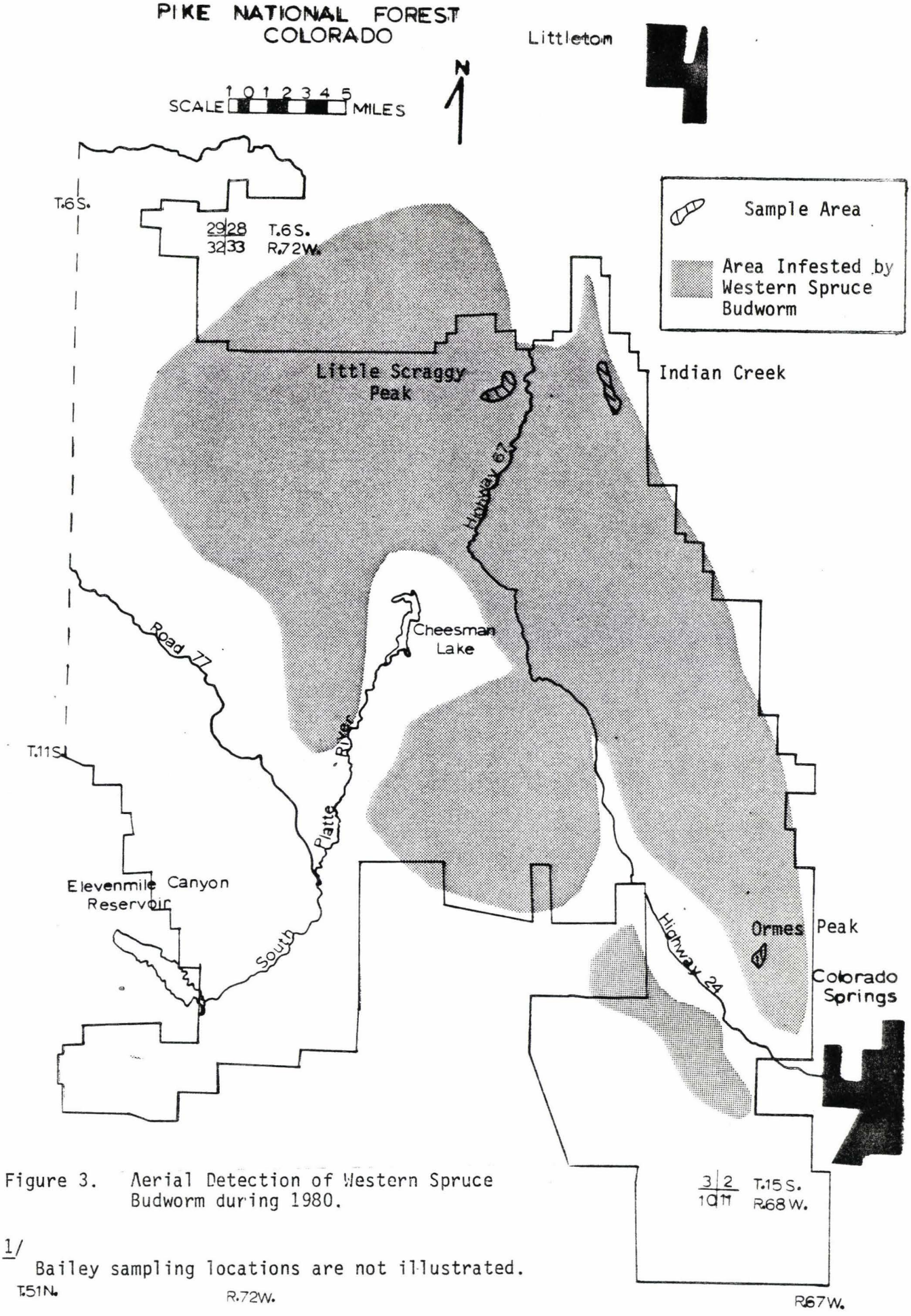

Figure 3. Aerial Detection of Western Spruce Budworm during 1980.

1/ Bailey sampling locations are not illustrated.

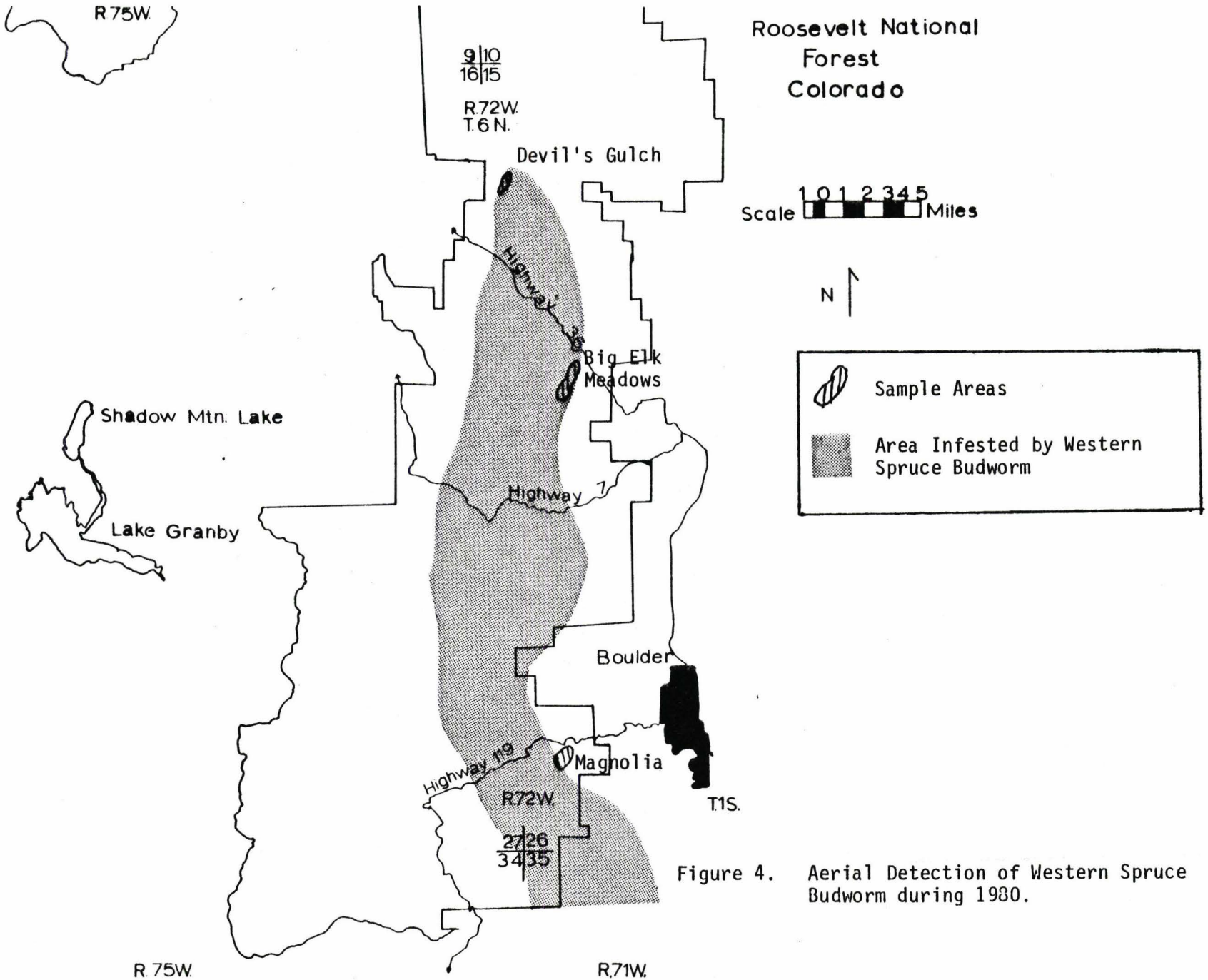

Figure 4. Aerial Detection of Western Spruce Budworm during 1980.

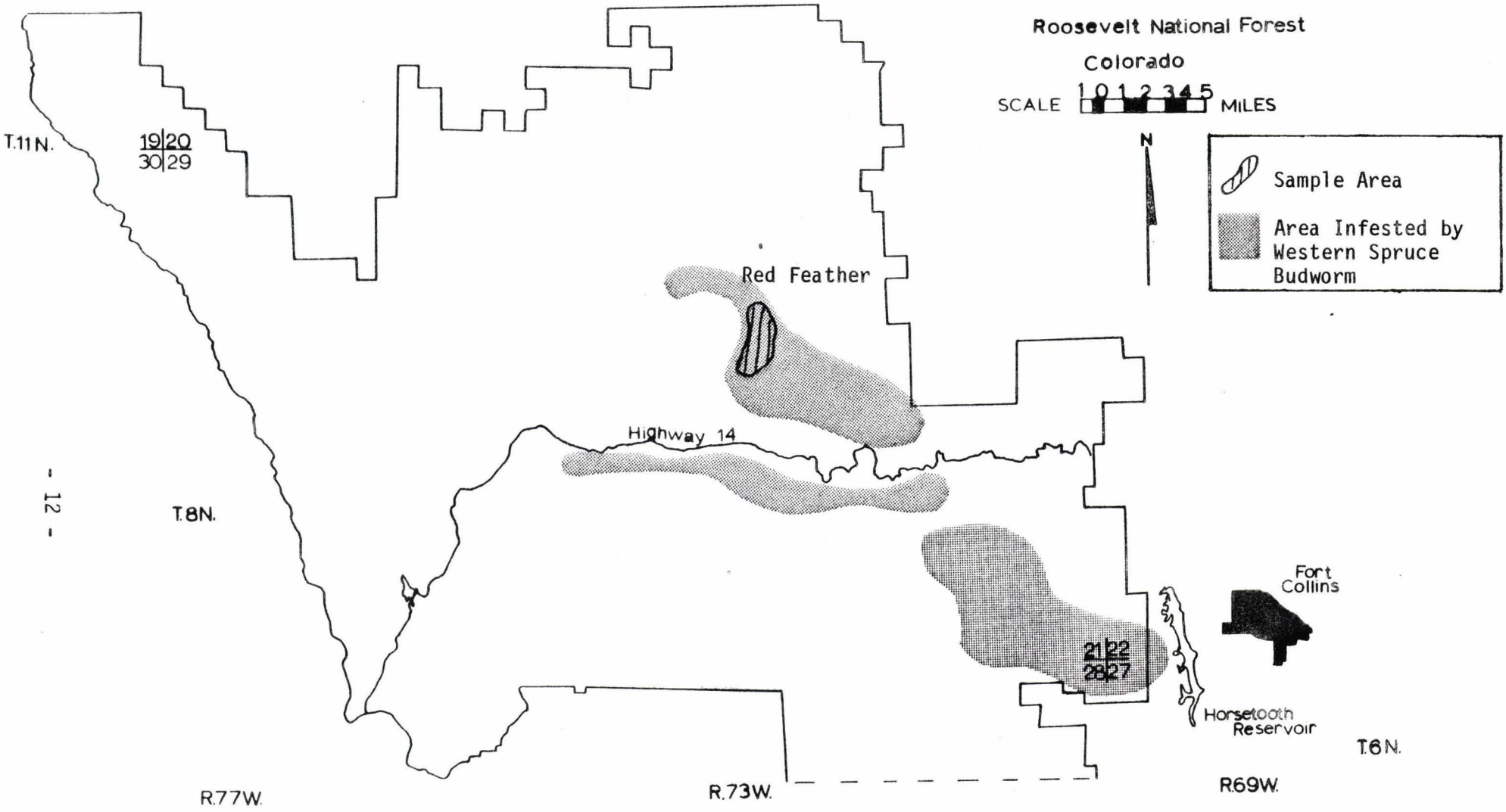

Figure 5. Aerial Detection of Western Spruce Budworm during 1980.

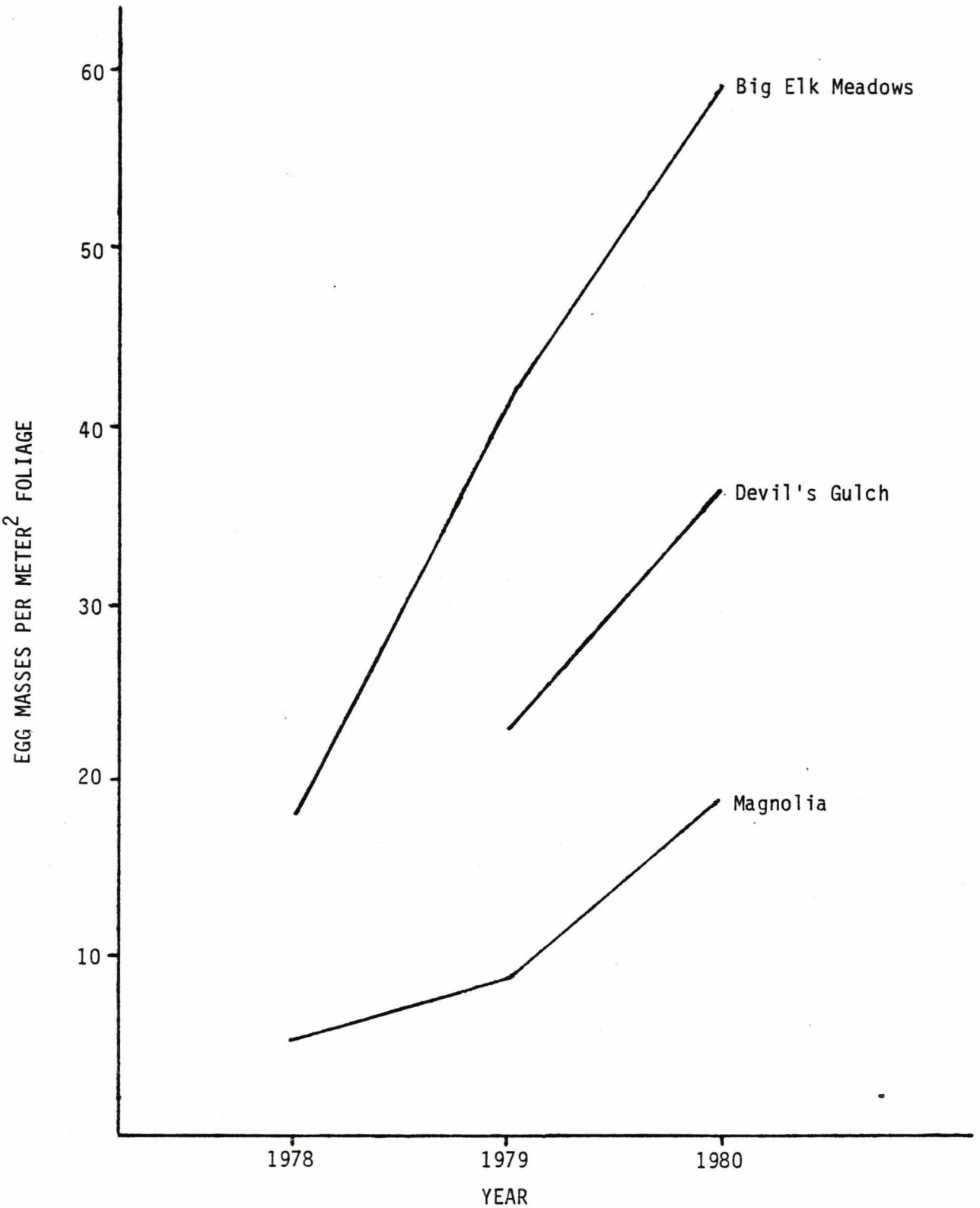

Figure 6. Western spruce budworm egg mass density trends for the Roosevelt National Forest. Densities based on permanent sample plots. 1/

1/ Trend information for the Red Feather sampling location is incomplete.

Roosevelt National Forest: Tree damage and defoliation is severe in Douglas-fir stands on this Forest. Top-kill and limited tree mortality has occurred in chronically infested areas (i.e. Big Elk Meadows - Johnny Park area). Budworm egg mass densities continue to be extremely high and heavy defoliation can be expected in 1981.

ALTERNATIVE ACTIONS

Alternative 1. Suppression with Chemical Insecticides. Effective aerial or ground applications of chemical insecticides will protect foliage from defoliation. Application costs are approximately $8-10/acre for aerial spraying and $6-7/tree for ground spraying. Sevin-4-Oil, Cythion ULV (malathion), Orthene, and Sevimol 4 are registered for aerial applications. Sevimol 4, Sevin-4-Oil, and Kryocide have specific registrations for ground application.

Alternative 2. Suppression with Microbial Insecticides. The microbial insecticide *Bacillis thuringiensis*,when properly applied, may protect foliage from defoliation, although results from applications elsewhere in the US and Canada have been somewhat erratic. *Bacillis thuringiensis* or B.t. is a specific insecticide for the Order Lepidoptera (butterflys and moths). B.t. is environmentally safe. It has no demonstrable impact on nontarget organisms. Costs are estimated at $12-15/acre for aerial applications and $8-10/tree for ground applications. The B.t. formulations Dipel and Thuricide are registered for aerial and ground application.

Alternative 3. No Action. This alternative options for the natural course of events. Defoliation and subsequent damage are assumed acceptable. The insect epidemic will eventually be suppressed by natural controls.

RECOMMENDATIONS

The general recommendation is Alternative 3, No Action. Considering the timber values of budworm susceptible stands within the Region, it is not likely suppression of budworm populations with chemical or microbial insecticides can be justified. However, protection from defoliation may be desirable and feasible within high value or high use areas, such as campgrounds, picnic grounds, areas of high scenic value, Christmas tree production areas, and other areas of high aesthetic value. In these situations, Alternative 1 or 2 may be appropriate.

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